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		First Named Inventor or Application Identifier James M. Lipsit		
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APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.		ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, D.C. 20231		
1. <input checked="" type="checkbox"/> Fee Transmittal Form <small>(submit an original, and a duplicate for fee processing)</small> 2. <input checked="" type="checkbox"/> Specification [Total Pages 39] <small>(preferred arrangement set forth below)</small> - Descriptive title of invention - Cross References to Related Applications - Statement Regarding Fed sponsored R&D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 3. <input checked="" type="checkbox"/> Drawing(s) (35 USC 113) [Total Sheets 10] 4. Oath or Declaration [Total Pages 2] a. <input type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 CFR 1.53(d)) <small>(for continuation/divisional with Box 17 completed)</small> <small>[Note Box 6 below]</small> i. <input type="checkbox"/> DELETION OF INVENTOR(S) <small>Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 163(d)(2) and 1.33(b)</small> 5. <input type="checkbox"/> Incorporation by reference (useable if Box 4b is checked) <small>The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference herein.</small>		6. <input type="checkbox"/> Microfiche Computer Program (Appendix) 7. <input type="checkbox"/> Nucleotide and/or Amino Acid Sequence Submission <small>(if applicable, all necessary)</small> a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies <div style="text-align: center;">ACCOMPANYING APPLICATION PARTS</div> 8. <input type="checkbox"/> Assignment Papers (cover sheet & document(s)) 9. <input type="checkbox"/> 37 CFR 3.73(b) Statement <input type="checkbox"/> Power of Attorney 10. <input type="checkbox"/> English Translation Document (if applicable) 11. <input checked="" type="checkbox"/> Information Disclosure <input checked="" type="checkbox"/> Copies of IDS <small>Statement (IDS/PTO-1449) Citations</small> 12. <input type="checkbox"/> Preliminary Amendment 13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small> 14. <input type="checkbox"/> Small Entity <input type="checkbox"/> Statement filed in prior application, <small>Statement(s) Status still proper and desired</small> 15. <input type="checkbox"/> Certified Copy of Priority Document(s) <small>(if foreign priority is claimed)</small> 16. <input type="checkbox"/> Other :		
17. If a CONTINUING APPLICATION , check appropriate box and supply the requisite information: <input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior Application No:				
18. CORRESPONDENCE ADDRESS				
<input type="checkbox"/> Customer Number or Bar Code Label		<div style="border: 1px solid black; width: 200px; height: 40px; margin: 0 auto;"></div> <small>(Insert Customer No. or Attach bar code label here)</small>		or <input checked="" type="checkbox"/> Correspondence address below
NAME	Samuel H. Dworetzky			
ADDRESS	AT&T CORP., P.O. BOX 4110			
CITY	STATE	NEW JERSEY	ZIP CODE	07748-4801
COUNTRY	UNITED STATES		FAX	732-957-5505
19. SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED				
NAME	Samuel H. Dworetzky		Reg. #	27873
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SIGNATURE			DATE	NOV. 28, 2000
"Express Mail" Mailing Label Number EL700776915US		Date of Deposit 11/28/00		
I hereby certify that this Application is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner of Patents, Washington D.C., 20231				
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PTO/SB/r17 Modified 02-98 AT&T Corp.

FEE TRANSMITTAL

Patent Fees are subject to annual revision on October 1

These are the fees effective October 1, 1997

Small Entity payments must be supported by a small entity Statement, otherwise, large entity fees must be paid. See Forms PTO/SB/09-12.

Complete if Known

Application Number

Filing Date

First Named Inventor

James M. Lipsit

Examiner Name

Group/Art Unit

Attorney Docket No.

1999-0074

TOTAL AMOUNT OF PAYMENT (\$ 2204.00

METHOD OF PAYMENT (check one)

1. The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit
Account
Number

01-2745

Deposit
Account
Name

AT&T CORP.

Charge Any Additional
Fee Required Under
37 CFR 1.16 and 1.17Charge the Issue Fee Set in
37 CFR 1.18 at the Mailing of the
Notice of Allowance

2. ☐ Payment Enclosed:
☐ Check ☐ Money Order ☐ Other

FEE CALCULATION**1. FILING FEE**

Large Fee Code	Entity Fee(\$)	Fee Description	Fee Paid
101	710	Utility Filing Fee	710.00
106	330	Design Filing Fee	
107	540	Plant Filing Fee	
108	790	Reissue Filing Fee	
114	160	Provisional Filing Fee	
SUBTOTAL (1) (\$)			710.00

2. CLAIMS

Total Claims	Extra Claims	Fee from below	Fee Paid
63 20=	43 X	18	= \$774.00
Independent Claims = 12 - 3	9 X	80	= \$720.00
Multiple Dependent Claims			=

Large Fee Code	Entity Fee(\$)	Fee Description
103	22	Claims in excess of 20
102	82	Independent Claims in excess of 3
104	270	Multiple Dependent Claims
109	82	Reissue independent claims over original patent
110	22	Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ 1494.00

FEE CALCULATION (continued)

Large Fee Code	Entity Fee(\$)	Fee Description	Fee Paid
105	130	Surcharge - late filing fee or oath	
127	50	Surcharge - late provisional filing fee or cover sheet	
139	130	Non-English specification	
147	2520	For filing a request for reexamination	
112	920*	Requesting publication of SIR prior to Examiner action	
113	1840*	Requesting publication of SIR after to Examiner action	
115	110	Extension for reply within first month	
116	400	Extension for reply within second month	
117	950	Extension for reply within third month	
118	1510	Extension for reply within fourth month	
128	2080	Extension for reply within fifth month	
119	310	Notice of Appeal	
120	310	Filing a brief in support of an appeal	
121	270	Request for oral hearing	
138	1510	Petition to institute a public use proceeding	
140	110	Petition to revive - unavoidable	
141	1320	Petition to revive - unintentional	
142	1320	Utility issue fee (or reissue)	
143	450	Design issue fee	
144	670	Plant issue fee	
122	130	Petitions to the Commissioner	
123	50	Petitions related to provisional applications	
126	240	Submission of Information Disclosure Statement	
581	40	Recording each patent assignment per property (lines number of properties)	
146	790	Filing a submission after final rejection(37 CFR 1.129(a))	
149	790	For each additional invention to be examined (37 CFR 1.129(b))	
Other fee (specify)			
Other fee (specify)			

* Reduced by Basic Filing Fee Paid

SUBTOTAL(3)

SUBMITTED BYTyped or
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Samuel E. Iwarsky

Signature

Date

11/28/00

Deposit Account User ID

Complete (if applicable)

Reg. Number

27873

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TESTING METHODS AND APPARATUS FOR WIRELESS COMMUNICATIONS

BACKGROUND OF THE INVENTION

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1. Field of the Invention

The present invention relates generally to the field of testing methods and apparatus for wireless communications, such as cellular telephone communications.

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2. Description of the Related Art

Conventional testing methods for use in wireless communications, such as cellular telephone communications, employ a laptop computer connected to a wireless communication device, such as a cellular telephone. During "drive testing," software in the laptop computer records data, such as signal strength data and channel identification data. The software may also provide some automated control of the cellular telephone, such as an automated repetitive dialing of telephone numbers for making telephone calls. The laptop computer is connected to the cellular telephone via a serial interface connection that is unique to the make and/or model of the cellular telephone. Software in the laptop computer that facilitates data communication with the cellular telephone is also unique to the cellular telephone's make and/or model. Also, the laptop computer is dedicated to the cellular telephone during the test.

Other conventional testing methods make use of an audio coupler, such as the "Auto Coupler" device provided by Gentner Communications Corporation of Salt Lake City, Utah, U.S.A. An audio coupler is connectable to a telephone land line and an audio source, such as an FM radio source. Cellular telephones can access the audio coupler and its accompanying audio signals by dialing a telephone number associated with the land line. The connection between the cellular telephone and audio coupler is established with the use of switching

software. Thus, a user has the ability to listen to the audio quality of the audio signals from the cellular telephone.

The conventional testing methods described above are limited. Only a particular type of cellular telephone can operate in connection with the laptop computer and its software, and multiple cellular telephones at different geographic locations cannot be simultaneously tested by it. The testing methods using the audio coupler are more flexible since a number of different types of cellular telephones may access it; however, this provides too much accessibility. In addition, the test functionality provided by the audio coupler is limited.

Accordingly, there is an existing need to provide more flexible, efficient, user-friendly, and secure testing methods and apparatus for wireless telephone communications.

SUMMARY OF THE INVENTION

Several testing methods and apparatus described herein relate to the use of a computer test station that provides the ability to simultaneously test the operations of a plurality of wireless telephone units within a wireless communication system. The computer test station resides at a location that is remote from the wireless telephone units. Users of the wireless telephone units set up operational tests by placing telephone calls to the computer test station and selecting from a plurality of available test functions. When a call is made to the computer test station, security is provided by screening caller identification (ID) numbers and/or personal identification numbers (PINs) from the wireless telephone units. Additional security is provided by assigning an abbreviated dialing number (e.g., "#TEST") to the computer test station for sole access thereto, which inhibits access to the computer test station by those wireless telephone units assigned to a different service provider. The selected test functions are executed by the computer test station sometime after the setup calls are terminated. The computer test station stores test data regarding the

execution of the tests for each wireless telephone unit, preferably in association with its corresponding caller ID information for optimal organization.

Thus, one inventive method for use in testing the operation of a wireless telephone unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit includes the steps of receiving a telephone call from the wireless telephone unit; receiving, during the telephone call, signals for selecting one of a plurality of test functions; receiving, during the telephone call, one or more parameters for execution of the selected test function; and executing, after termination of the telephone call, a predetermined test process corresponding to the selected test function using the one or more parameters.

Another method for use in testing the operation of a wireless telephone unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit includes the steps of receiving caller identification (ID) information associated with a wireless telephone unit during a wireless communication therefrom; receiving dual-tone multiple frequency (DTMF) signals from the wireless telephone unit during the wireless communication; selecting one of a plurality of test functions based on the DTMF signals; after termination of the wireless communication, executing the selected test function and receiving test data associated with the wireless telephone unit; and storing the test data in association with the caller ID information. A related method for use in simultaneously testing a plurality of wireless telephone units operative for wireless communications includes the steps of receiving first caller identification (ID) information associated with a first wireless telephone unit; performing a first test function during a first time period in connection with the first wireless telephone unit and generating first test data therefrom; storing the first test data in association with the first caller ID information; receiving second caller identification (ID) information associated with a second wireless telephone unit; performing a second test function during a second time period in connection with the second wireless telephone unit and generating second test

data therefrom; and storing the second test data in association with the second caller ID information.

A method for use in providing a telephone unit with remote access to functions of a computer processor includes the steps of receiving a telephone call
5 from a telephone unit; receiving a caller identification (ID) number of the telephone unit upon receiving the telephone call; comparing the caller ID number with a plurality of prestored caller ID numbers; and granting or denying access to functions of the computer processor based at least in part on the comparing. This method may include the further steps of receiving a personal identification
10 number (PIN) selected at the telephone unit; comparing the PIN with a prestored PIN associated with a prestored caller ID number that matches the received caller ID number; wherein granting or denying access is based at least in part on the comparing of the caller ID number and the comparing of the PIN.

A particular test function for testing the operation of a wireless telephone
15 unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit includes the steps of initiating a telephone connection request to the wireless telephone unit; detecting whether a connection was made with the wireless telephone unit in response to initiating the telephone connection request; repeating the initiating and detecting a total
20 number of N times; and storing data indicative of a number of connections made with the wireless telephone unit during the repeated initiating and detecting. Another particular test function for use in testing the operation of a wireless telephone unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit includes the steps of
25 sending audio signals during a telephone connection with the wireless telephone unit; detecting a disconnection with the wireless telephone unit; initiating a telephone connection request to the wireless telephone unit if a disconnection is detected; repeating the sending, and any detecting and initiating, over a time period T; and storing data indicative of a number of disconnections with the
30 wireless telephone unit over the time period T.

A test station for testing the operation of a wireless telephone unit within a wireless communication system may include a computer; wireless communication test software residing on memory that is accessible to the computer; a computer telephony card coupled to the computer, where the computer telephony card has a plurality of telephone line interfaces, and each telephone line interface is associated with a respective one of a plurality of telephone numbers of a hunt group. Another test station for testing a wireless telephone unit within a wireless communication system may include a computer; wireless communication test software residing on memory that is accessible to the computer; a computer telephony card coupled to the computer, where the computer telephony card has at least one telephone line interface that is accessible by an abbreviated dialing telephone number. A related telecommunication system method for providing a plurality of wireless telephone units with remote access to a computer test station includes the steps of receiving an abbreviated dialing telephone number to establish a telephone call connection; selecting one of a plurality of telephone numbers of a hunt group that is associated with the abbreviated dialing telephone number, each one of the plurality of telephone numbers being associated with a computer test station; and facilitating the telephone call connection between a wireless telephone unit and the computer test station with use of the selected telephone number.

Finally, a preferred method for use in troubleshooting a call in a wireless communication system by a computer test station includes the steps of receiving a telephone call from a wireless telephone unit while the wireless telephone unit is simultaneously connected in a call; receiving, during the telephone call, first information which identifies the wireless telephone unit and second information which identifies a wireless switch utilized in the call; sending, during the telephone call, a call trace request with use of the first and the second information; and receiving, in response to sending the call trace request, call trace information including information that identifies a plurality of devices of the wireless switch utilized in the call.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustrative representation of a telecommunication system,
5 which includes a wireless communication system, utilizing a computer test
station;

FIG. 2 is a schematic block diagram of a wireless telephone unit in the
10 wireless communication system of FIG. 1;

FIG. 3 is an illustration of various software components which may be
utilized in connection with the methods executed at the computer test station;

FIG. 4 is an illustrative representation of the selections involved in
15 connecting a telephone call between the computer test station and a wireless
telephone unit;

FIG. 5 is a flowchart describing a method for use in accessing the computer
test station;

20 FIG. 6 is an illustrative representation of a plurality of test functions
available at the computer test station;

FIG. 7 is a flowchart describing a method for use in testing within the
25 telecommunication system;

FIG. 8 is a flowchart describing a method of setting up a test function,
namely an answered call test, for execution by the computer test station;

FIG. 9 is a flowchart describing a method of executing the test function which was setup as described in relation to FIG. 8;

FIG. 10 is an illustrative representation of a visual presentation of test data
5 from the execution of the test function as described in relation to FIG. 9;

FIG. 11 is a flowchart describing a method of executing a test function, namely a dropped call test; and

10 FIG. 12 is a flowchart describing a method of executing a troubleshooting function which provides call tracing for problematic telephone calls.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

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FIG. 1 is a block diagram of a telecommunication system 100. Telecommunication system 100 includes a public switched telephone network (PSTN) 108 and a wireless communication system 102. In this embodiment, wireless communication system 102 is a cellular telephone system having a
20 plurality of mobile telephone switching offices (MTSO), such as an MTSO 106, and a plurality of base stations coupled to the MTSSOs, such as base stations 112, 114, and 116 coupled to MTSO 106. A plurality of wireless telephone units 104 are served by the plurality of base stations 102 in wireless communication system 102, such as wireless telephone units 118 and 120 being served by base station
25 114. In making wireless connections for calls, the MTSSOs operate and select from a plurality of devices 134, which is described in more detail below.

A computer test station 110 is coupled to telecommunication system 100 and is located remotely from the plurality of wireless telephone units 104. Computer test station 110 includes a computer 124, a computer telephony card
30 126, a central processing unit (CPU) or computer processor 128, a memory 130, a

software application 122, and a database 132. Application 122 includes wireless telephone communication test software which is executed by computer processor 128. Application 122 is executable to perform test functions, test setup functions, and to control computer telephony card 126, as described in more detail below.

5 Referring ahead to FIG. 3, the methods described herein may be embodied and implemented more generally in connection with software using software components 300 shown in FIG. 3. The software may be embedded in or stored on a disk 302 or memory 304, executable on a computer 306 or a processor 308. Thus, the inventive features may exist in a signal-bearing medium which
10 embodies a program of machine-readable instructions executable by a processing apparatus which perform the methods.

Referring back to FIG. 1, computer telephony card 126 has a telephone line interface for coupling to a plurality of land lines (e.g., four land line interfaces associated with four different telephone numbers). Computer telephony card 126
15 is used for telephonic functions, encode and decode, and line selection. Computer telephony card 126 preferably embodies a voice response unit (VRU) for accessing and selecting functions of computer test station 110. A suitable computer telephony card 126 may be provided by Dialogic™ of Parsippany, New Jersey, U.S.A.

20 FIG. 2 is a schematic block diagram of wireless telephone unit 118 of wireless communication system 102 of FIG. 1. Wireless telephone unit 118 of FIG. 2 may be representative of each wireless telephone unit utilized in wireless communication system 102 of FIG. 1. Wireless telephone unit 118 has an antenna 202, a wireless receiver 204 and a wireless transmitter 206 coupled to antenna
25 202, one or more processors 208 which control reception and transmission, and a user interface 210 also controlled by one or more processors 208. User interface 210 of wireless telephone unit 118 may include one or more of a keypad 212, a visual display 214, a speaker 216, and a microphone 218. Keypad 212 may include a dual-tone multiple frequency (DTMF) keypad. Visual display 214 is
30 utilized for confirmation of user-selected information and for the display of

messages and visual presentations. Speaker 216 and microphone 218 are utilized for listening and speaking, respectively, in telephonic communications. Wireless telephone unit 118 may be a cellular telephone which has a unique Mobile Identification Number (MIN) or caller identification (ID) number associated therewith.

FIG. 4 is an illustrative representation related to the use of an abbreviated dialing telephone number, such as "#TEST" (or #8378), for use by multiple wireless telephone units in accessing computer test station 110 of FIG. 1. "Abbreviated Dialing" and the use of abbreviated dialing telephone numbers are well-known, but not in connection with computer test station 110 for testing wireless communications as described herein. Referring to FIGs. 1 and 4 in combination, wireless telephone unit 118 initially dials #TEST in an attempt to access computer test station 110. The telephone connection request with #TEST is received at MTSO 106. MTSO 106 substitutes #TEST with a telephone number (via a lookup table) and transfers the request to PSTN 108. It is noted that the abbreviated telephone number, #TEST, is not recognizable by MTSOs of other service providers. In addition, the telephone number submitted to PSTN 108 is generally not usable in a direct fashion by any telephone unit for connection. PSTN 108 receives this telephone number and selects an available number (i.e., one that is not in use) from a plurality of telephone numbers of a "hunt group" associated therewith. Each one of the plurality of telephone numbers of the hunt group is associated with a corresponding land line coupled to computer telephony card 126.

Each time a wireless telephone unit dials in, a new instance of the test application is utilized. When multiple wireless telephone units are being served by computer test station 110 simultaneously, multiple instances of the test software are running. Using the same abbreviated dialing number, then, multiple wireless telephone units may access computer test station 110 at the same or different times, and select from a number of different functions. Advantageously, computer test station 110 is associated with an easy-to-

remember access number and multiple wireless units can use computer test station 110 simultaneously. Another result, somewhat unexpected, is that only wireless telephone units having service associated with MTSO 106 are allowed access to computer test station 110; others cannot gain access.

Referring ahead to FIG. 6, computer test station 110 of FIG. 1 is equipped to execute a plurality of tests or test functions 606, such as a test function 608, a test function 610, a test function 612, and a test function 614. Test function 608 may be, for example, an answered call test as described later in relation to FIGs. 8-10, and test function 610 may be, for example, a dropped call test as described later in relation to FIG. 11. Computer test station 110 of FIG. 1 may receive test code data 602 in the form of DTMF signals which are selected at wireless telephone unit 118 (via its user interface). Here, a decoder 604 is utilized to detect one of a plurality of different test codes which uniquely corresponds to one of the plurality of test functions 606. Preferably, decoder 604 is part of the VRU utilized at computer test station 110. Thus, computer test station 110 provides voice prompting for the wireless telephone units for system access and test selection. The selected test function is executed by computer test station 110 sometime after its selection by wireless telephone unit 118.

FIG. 5 is a flowchart describing a method for use in accessing computer test station 110. Beginning at a start block 500, computer test station 110 receives a telephone call from wireless telephone unit 118 when a user of wireless telephone unit 118 dials "#TEST" (step 502). Being able to handle simultaneous telephone calls and tests, computer test station 110 selects one of a plurality of telephone lines for the telephone call (step 504) and executes an (additional) instance of the test application program (step 506). Upon receiving the telephone call, computer test station 110 receives caller ID information from wireless telephone unit 118 (step 508). Computer test station 110 prompts wireless telephone unit 118 to enter a personal identification number (PIN). The user of wireless telephone unit 118 enters the PIN (for example, via DTMF keypad) and computer test station 110 receives this data (step 510).

In database 132, each number of a plurality of caller ID numbers is stored in association with a unique prestored PIN. Computer test station 110 compares the received PIN with a PIN stored in association with a matching prestored caller ID number (step 512). Computer test station 110 grants or denies access to functions of computer test station 110 based on the comparison (step 514). More particularly, if computer test station 110 does not find a matching caller ID number, then access is denied. If computer test station 110 finds a matching caller ID number, but the received PIN does not match the prestored PIN stored in association with the prestored caller ID number, then access is denied. If computer test station 110 finds a matching caller ID number, and the received PIN matches the prestored PIN, then access is granted. The flowchart ends at a finish block 516.

In an alternate embodiment, as indicated by a dashed arrow 518 in FIG. 5, computer test station 110 compares the caller ID information with prestored caller ID numbers in database 132 and grants or denies access to functions of computer test station 110 based on the comparison (step 514). More particularly, if the caller ID information received matches one of the caller ID numbers prestored in database 132 then access is granted; otherwise access is denied. Thus, a simple preestablished relationship may provide access to computer test station 110. In this embodiment, no prompting for any user information (e.g., PIN) is necessary.

In another alternate embodiment, steps 510 and 512 are performed for wireless telephone unit 118 only during its initial telephone call to computer test station 110. In this method, if the selected PIN for the initial call matches the prestored PIN, computer test station 110 stores a positive data indication in association with the prestored caller ID number for wireless telephone unit 118 and grants access. For subsequent calls from wireless telephone unit 118, computer test station 110 grants access if the received caller ID matches the prestored caller ID, without any prompt for entry of a PIN.

The methods described in relation to FIG. 5 may be embodied in applications different from computer test stations. For example, the methods described may be embodied in a computer processor of an otherwise conventional answering machine. As another example, the methods may be embodied in a computer processor of an otherwise conventional home appliance automation system. In each application, multiple unique caller IDs (as well as prestored PINs) may be stored for granting access to multiple members of a household having multiple cellular telephones. In each application, multiple conventional functions (retrieve/save/delete voice message functions, selection function for home appliance, control function for on/off power of home appliance, etc.) may be executed after access is granted using the methods described.

FIG. 7 is a flowchart describing a testing method for use in the telecommunication system of FIG. 1. Beginning at a start block 700, computer test station 110 receives a call from wireless telephone unit 118 (step 702). In connection with this call, computer test station 110 receives caller ID information from wireless telephone unit 118 (step 704). As previously described, computer test station 110 has a plurality of different test functions, each one of which is associated with a particular test identification code. In response to a selection made at wireless telephone unit 118 via the user interface (for example, via DTMF signals), computer test station 110 receives and detects one of the plurality of test identification codes (step 706). In response, computer test station 110 selects one of the plurality of test functions based on the test identification code (step 708).

Sometime thereafter, computer test station 110 executes the test function associated with the test identification code (step 710). The execution of the test function typically involves calls between computer test station 110 and wireless telephone unit 118, where computer test station 110 receives and monitors events and/or conditions of the test. Thus, computer test station 110 receives test data during the execution of the test function (step 712). The test may be relatively

brief, or span over a long period of time. Computer test station 110 may perform analysis and computations on the test data it receives. In any case, computer test station 110 stores the test data, events and/or conditions, in association with the caller identification information previously received (step 714). The flowchart
5 ends at a finish block 716, but the method described may repeat for a plurality of different wireless telephone units and different test functions.

Advantageously, a number of different test data for a number of different wireless telephone units may be identified and organized appropriately at computer test station 110. Also advantageously, computer test station 110 is
10 operative to simultaneously execute the same or different tests for different wireless telephone units. This may be particularly useful where wireless telephone units 118 and 120 are being simultaneously tested with the same test and in the same test environment (e.g., both in the same moving vehicle).

As a more specific example regarding that described in relation to FIG. 7, a
15 DTMF audio signal corresponding to telephone digit "5" may be selected at wireless telephone unit 118 and received and detected at computer test station 110. Telephone digit "5" may uniquely correspond to a test function referred to as an autodial test or an answered call test. One implementation of the answered call test is described in relation to FIGs. 8 and 9.

FIG. 8 is a flowchart describing a method for configuring one particular
20 test function for execution, namely an answered call test. Beginning at a start block 800, computer test station 110 receives and detects a test identification code corresponding to the answered call test (step 802). This is one example of what may occur during steps 706 and 708 of FIG. 7. In response, computer test station
25 110 prompts (via the VRU) wireless telephone unit 118 to select test parameters for the answered call test. For example, computer test station 110 prompts wireless telephone unit 118 to select a number of calls N to send. Here, the end-user of wireless telephone unit 118 selects this information via the user interface and computer test station 110 receives data indicative of the number of calls N to
30 send (step 804). As another example, computer test station 110 prompts wireless

telephone unit 118 to select a time T (e.g., date and time, or expiration of time after hangup) to commence the testing. Here, the end-user of wireless telephone unit 118 selects this information via the user interface and computer test station 110 receives data indicative of the time T to commence the test (step 806). The call between computer test station 110 and wireless telephone unit 118 is then terminated, and the flowchart ends at a finish block 808. The answered call test, described in relation to FIG. 9, will commence at the selected time T.

FIG. 9 is a flowchart describing a method of testing a wireless telephone unit using the answered call test. Beginning at a start block 900, computer test station 110 monitors the time and determines, at step 902, whether it is time to execute the answered call test. When it is time T, computer test station 110 executes the test function as will be described in connection with the subsequent steps. Computer test station 110 attempts to place a call to wireless telephone unit 118 using the caller identification information previously received and stored (step 904). If wireless telephone unit 118 is able to detect the call page from base station 114, it is able to answer the call; otherwise, it is not able to answer the call. If computer test station 110 detects that wireless telephone unit 118 is available to answer (step 906), then it tallies the call as answered (e.g., increments a counter corresponding to a number of answered calls) (step 908). The call between computer test station 110 and wireless telephone unit 118 is then terminated (step 910). If computer test station 110 detects that wireless telephone unit 118 is not available to answer at step 906, then it tallies the call as not answered (e.g., increments a counter corresponding to a number of unanswered calls) (step 909).

Continuing at step 912 of FIG. 9, computer test station 110 determines if the number of placed test calls is equal to the number of calls N previously selected (step 912). If not, steps 904 through 912 are repeated as shown. If so, the test is mostly completed. Computer test station 110 generates any further information (step 914) and stores all of the test information from the test in association with the caller ID information previously received (step 916). The

further information generated in step 914 could be, for example, based on an analysis of all of the test data and/or proper format for presentation or data input. The analysis could include, for example, calculations of percentages, comparisons with other test data from the same or different wireless telephone units, etc. The method ends at a finish block 918, but may repeat for the same or different wireless telephone units. Since computer test station 110 is equipped to simultaneously handle multiple wireless telephone unit tests, this particular method described may be employed simultaneously for multiple wireless telephone unit tests.

FIG. 10 is an illustrative representation of a presentation 1000 from computer test station 110 which shows test data 1002 for multiple wireless telephone units with respect to the answered call test. The first column of data recites the name of the particular data field, and each remaining column provides test data associated with a particular wireless telephone unit. As shown, test data 1002 may include test time/date data 1004, caller ID or MIN data 1006, total calls attempted data 1008, total calls failed data 101, and specific data 1012 regarding the time and success/failure indication. Other useful data is stored and viewable as shown in FIG. 10. As shown, test data is stored in proper association with caller ID/MIN information of each wireless telephone unit. Other data may include, for example, data that identifies where the wireless telephone unit was located for each attempted call.

FIG. 11 is a flowchart describing a method of testing a wireless telephone unit using a test referred to as a "dropped call test," which may also be utilized as an audio quality test. This test may be invoked similarly to that described in relation to FIGs. 8 and 9, that is, by selectively preprogramming the execution of the test function at a particular time or time delay, and using user-selected parameters. Beginning at a start block 1100, where a telephone call has already been established between computer test station 110 and wireless telephone unit 118, computer test station 110 sends audio test signals, such as a predetermined speech sample, to wireless telephone unit 118. These audio test signals may be,

for example, male and female voice signals provided by the Telecommunications Industry Association (TIA).

During the telephone call, computer test station 110 detects whether the call has been dropped (step 1104). If the call has not been dropped at step 1104, computer test station 110 determines whether a preselected time period has expired (step 1110). Preferably, the preselected time period is one which was preselected by wireless telephone unit 118 during a previous communication (e.g., similar to that described in relation to FIG. 8). If the time has not expired at step 1110, then computer test station 110 continues monitoring these events back at step 1104. If it is detected that the call has been dropped at step 1104, computer test station 110 tallies it as a dropped call (e.g., by incrementing a counter) (step 1106). Then, computer test station 110 automatically calls back wireless telephone unit 118 using the caller ID information (step 1108). If the time has expired at step 1110, computer test station 110 records the information regarding the total test time and the number of calls dropped over that time period (step 1112). The method ends at a finish block 1114, but may repeat for subsequent tests. Other data stored may include, for example, data that identifies where the wireless telephone unit was geographically located for each dropped call.

FIG. 12 is a flowchart describing a method for use in troubleshooting in a telecommunication system. Beginning at a start block 1200, a telephone call from a wireless telephone unit is received at the computer test station 110 (step 1202). The wireless telephone unit places this telephone call while it is simultaneously connected in a problematic telephone call. In this described method, computer test station 110 operates in a mode to identify the set of functionally different devices utilized in the problematic call. To place this three-way telephone call, the wireless telephone unit is enabled for a three-way calling feature which is well-known in the art.

The problematic telephone call could be due to, for example, one of many conventional devices utilized in the call that is not operating properly. For

example, the problematic device may be an "echo canceller" that is not operating properly. Referring back to FIG. 1, MTSO 106 utilizes a plurality of devices 134 for the connection of telephone calls, as do other MTSOs. As shown in FIG. 1, each row of the plurality of devices 134 corresponds to devices that are functionally different, while each column shown corresponds to devices that are functionally the same. For each call established, a different set of functionally different devices are selected and utilized. For example, column 1 ("A" devices) may correspond to a plurality of echo canceller devices (one of which is utilized in a connected call), column 2 ("B" devices) may correspond to a plurality of base station radio devices (one of which is utilized in a connected call), and column 3 ("C" devices) may correspond to a plurality of PSTN route devices (one of which is utilized in a connected call), etc.

Referring back to FIG. 12, caller ID information is sent from the wireless telephone unit and received at computer test station 110 (step 1204). Next, a user of the wireless telephone unit enters information (for example, DTMF signals) to identify the switch utilized in the problematic call, and computer test station 110 receives this data (step 1206). During the three-way telephone call, computer test station 110 records and stores audio signals of the problematic call in a file (e.g., a ".wav" file) (step 1208). Computer test station 110 sends a call trace request through the network using the switch identification information and the caller ID information (step 1210). More specifically, computer test station 110 automatically looks up in a table an IP address associated with the switch, connects to the switch using the IP address, logs in, and issues a trace command with the mobile number.

The network responds to the trace command by sending computer test station 110 call trace information that includes an identification of a plurality of devices utilized in the problematic call (step 1212). Next, computer test station 110 sends a message having at least some of the call trace information and the audio file to a predetermined address (step 1214). Prior to sending the message, computer test station 110 may parse out only that information necessary. Text

information of the message may indicate that a problem has been encountered (for example, "PLEASE CHECK OR REPLACE THE ECHO CANCELLER IDENTIFIED IN THIS CALL"). The message may be sent to wireless telephone unit 118, to some computer device to initiate repairs (e.g., a system maintenance computer), or both. The message may be, for example, an electronic mail (e-mail) message where the audio file is sent as an attachment or enclosure. If a message is sent to wireless telephone unit 118, computer test station 110 uses the caller ID information as the email address of wireless telephone unit 118. The method ends at a finish block 1216, but may repeat for subsequent calls and requests.

The call trace information received in step 1212 may read as follows:

```
=====
Trace Captured Date & Time:      11/09/1999 11:36:11 AM
Switch:                          BOYNTON
Mobile Number:                   5613461655

WO          PBIT2*195005*14729AS1H  AT-32   TIME 991109 1138  PA
<CTRAI:SNB=5613461655;
CALL PATH TRACING

XSS TRACING

IDX SWDEV          DEV          DEVIDX  FID
1   MTA-1930
2   CHCDR-2095
3   MSCHC-2363
4   MSSH-695
5   CLCOP-2015
6   CHVIEW-1-764
7   MCHC-645
8   MPOOL-4069
9   MSEVR-35640
10  MAUTH-37897
11  MPRAUD-695
12  UPAPOTB-6597
13  SUPIA-1208
14  MDVC-3119
15  MECHO-2183
16  MAUTHD-2000
17  UPPCB-6597
18
19
20  UPAMHRB-6597
21  UPAMHSB-6597
22  UPLTD-2504

MBTRAC-4995
MECHO-2207

2   3   H'03AC 001C
4
5   1   H'03AC 001C
1   7   H'03AC 001C
8
1   9   H'03AC 001C
10  11
2   12  H'03AC 001C
13
3   14  H'03AC 001C
3   15  H'03AC 001C
4   16  H'03AC 001C
4
4   H'03AC 001C
4   H'03AC 001C
5   17  H'03AC 001C
5   H'03AC 001C
7   18  H'03AC 001C
8   19  H'03AC 001C
9
9   H'03AC 001C
20  12  H'0000 0001
21
14   H'03AC 001C
15   H'03AC 001C
17  22  H'0000 0001
17   H'0000 0001
23  20  H'0000 0001
```

23 UPDC-2504 24 22 H'0000 0001
 24 UPD24A-2504 23 H'0000 0001

5 SWITCH CONNECTED DEVICE

IDX	MUP	LINK	MUP
18	GS-30-451	GS-030027-241	
19	GS-27-167	GS-027031-500	
24	GS-31-208	GS-031027-244	

10

TAG IDX MISCDATA
 36 9 5613461655
 41 9 5613461655

15

AM TRAFFIC LEVEL TRACING

IDX	SWDEV	DEV	DEVIDX	FID
1	CHVIEW-1-764			H'03AC 001C
2	CHCDR-2095			

20

25 END

<

30

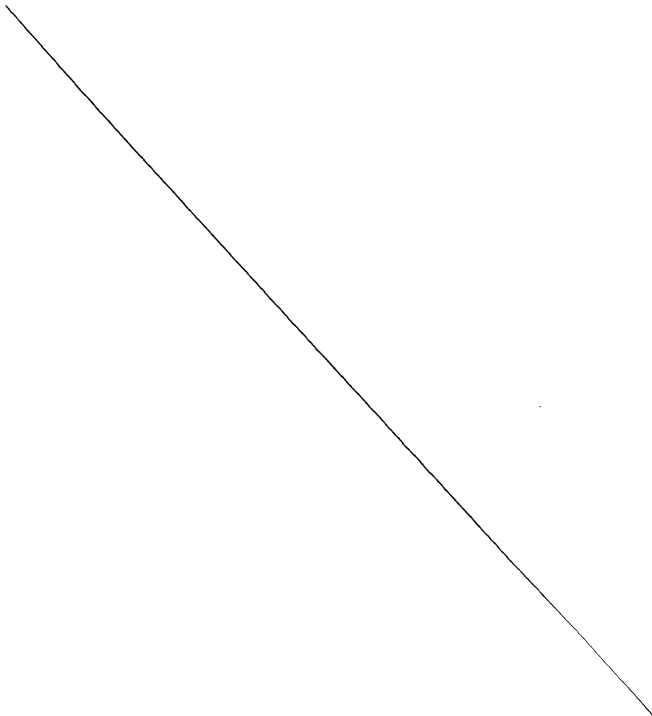
=====

Referring to the call trace information above, an echo canceller device may be found at number 15 or "MECHO," where the particular echo canceller device utilized in the call is identified by the number "2183." A base station radio device may be found at number 14 or "MDVC," where the particular base station radio device utilized in the call is identified by the number "3119." A PSTN route device may be found at numbers 18, 19, and 24 or "IDX MUP" and "LINK" where the particular PSTN route device utilized in the call may be identified by the associated alphanumeric information. The trace command is shown as "CTRAI:SNB=5613461655," where 5613461655 corresponds to the MIN of wireless telephone unit 118.

It should be readily apparent and understood that the foregoing description is only illustrative of the invention and in particular provides preferred embodiments thereof. Various alternatives and modifications can be devised by those skilled in the art without departing from the true spirit and scope of the invention. Accordingly, the present invention is intended to

embrace all such alternatives, modifications, and variations which fall within the scope of the appended claims.

What is claimed is:



CLAIMS

1. A method for use in troubleshooting a call in a wireless communication system by a computer test station, the method comprising:

receiving a telephone call from a wireless unit while the wireless unit is simultaneously connected in a call;

receiving, during the telephone call, first information which identifies the wireless unit and second information which identifies a wireless switch utilized in the call;

sending, during the telephone call, a call trace request using of the first and the second information; and

receiving, in response to sending the call trace request, call trace information including information that identifies a plurality of devices of the wireless switch utilized in the call.

2. The method according to claim 1 wherein receiving the first information comprises receiving caller identification (ID) information.

3. The method according to claim 1 wherein receiving the second information comprises receiving dual-tone multiple-frequency (DTMF) digits corresponding to a wireless switch identifier.

4. The method according to claim 1, wherein receiving call trace information comprises receiving information which identifies one echo canceller of a plurality of echo cancellers of the wireless switch utilized in the call.

5. The method according to claim 1, wherein sending the call trace request with use of the first and the second information comprises sending, to an address corresponding to the wireless switch, a trace command having caller ID information corresponding to the wireless unit.

6. The method according to claim 1, further comprising:
sending a message including at least portions of the call trace information
to the wireless unit.

5

7. The method according to claim 1, further comprising:
sending a message including at least portions of the call trace information
to a preselected address.

10

8. The method according to claim 1, further comprising:
recording and storing audio signals from the call as data in a file; and
sending a message including at least portions of the call trace information
and the file to a preselected address.

15

9. A computer test station for troubleshooting a call in a wireless
communication system, the computer test station comprising one or more
processors that:

receive a telephone call from a wireless unit while the wireless unit is
simultaneously connected in a call;

20

receive, during the telephone call, first information which identifies the
wireless unit and second information which identifies a wireless switch utilized
in the call;

send, during the telephone call, a call trace request with use of the first and
the second information; and

25

receive, in response to sending the call trace request, call trace information
including information that identifies a plurality of devices of the wireless switch
utilized in the call.

10. The computer test station according to claim 9 wherein, to receive the first information, said one or more processors are further executable to receive caller identification (ID) information.

5 11. The computer test station according to claim 9, wherein, to receive the second information, said one or more processors are further executable to receive dual-tone multiple-frequency (DTMF) digits corresponding to a wireless switch identifier.

10 12. The computer test station according to claim 9, wherein, to receive the call trace information, said one or more processors are further executable to receive information which identifies one echo canceller of a plurality of echo cancellers at the wireless switch utilized in the call.

15 13. The computer test station according to claim 9, wherein said one or more processors are further executable to send, to an address corresponding to the wireless switch, a trace command having caller ID information corresponding to the wireless unit.

20 14. The computer test station according to claim 9, wherein said one or more processors are further executable to send a message including at least portions of the call trace information to the wireless unit.

25 15. The computer test station according to claim 9, wherein said one or more processors are further executable to send a message including at least portions of the call trace information to a preselected address.

30 16. The computer test station according to claim 9, wherein said one or more processors are further executable to record audio signals from the call and store the recording as data in a file; and send a message including at least

portions of the call trace information and the file storing the audio signals to a preselected address.

17. A method for testing the operation of a wireless unit within a wireless communication system by a computer test station located remotely from the wireless unit, the method comprising:

receiving a telephone call from the wireless unit;

receiving, during the telephone call, signals for selecting one of a plurality of test functions;

receiving, during the telephone call, one or more parameters for execution of the selected test function; and

executing, after termination of the telephone call, a predetermined test process corresponding to the selected test function using the one or more parameters.

15

18. The method according to claim 17, wherein executing a predetermined test process comprises initiating one or more telephone connection requests to the wireless unit.

20

19. The method according to claim 17, further comprising:

receiving caller identification (ID) information of the wireless telephone unit in response to receiving the telephone call; and

wherein executing a predetermined test process comprises initiating one or more telephone connection requests to the wireless telephone unit using the caller ID information.

25

20. The method according to claim 17, wherein the one or more parameters comprise time information indicative of a time at which the predetermined test process is to be executed.

30

21. The method according to claim 17, wherein the one or more parameters comprise time information indicative of a time duration over which the predetermined test process is to be executed.

5 22. The method according to claim 17, wherein the one or more parameters comprise repetition information indicative of how many times a predetermined function will be executed.

23. The method according to claim 17, wherein the predetermined test
10 process corresponds to an answered call test comprising:

initiating a telephone connection request to the wireless unit;

detecting whether a connection was made with the wireless unit after
initiating the telephone connection request;

repeating the initiating and detecting a total number of N times, wherein
15 N is a number indicated in the one or more parameters; and

storing data indicative of a number of connections made with the wireless
unit during the repeated initiating and detecting.

24. The method according to claim 17, wherein the predetermined test
20 process corresponds to a dropped call test comprising:

sending audio signals during a telephone connection with the wireless
unit;

detecting a disconnection with the wireless unit;

initiating a telephone connection request to the wireless unit if a
25 disconnection is detected;

repeating the sending, detecting, and initiating over a time period T,
wherein T is indicated in the one or more parameters; and

storing data indicative of a number of disconnections with the wireless
unit over the time period T.

30

25. A computer test station for testing the operation of a remote wireless unit within a wireless communication system, the computer test station having one or more processors operative to;

receive a telephone call from the wireless telephone unit;

5 receive, during the telephone call, signals for selecting one of a plurality of test functions;

receive, during the telephone call, one or more parameters for execution of the selected test function; and

10 execute, after termination of the telephone call, a predetermined test process corresponding to the selected test function using the one or more parameters.

26. The computer test station according to claim 25 wherein, to execute a predetermined test process, said one or more processors are further operative
15 to initiate one or more telephone connection requests to the wireless unit.

27. The computer test station according to claim 25 wherein said one or more processors are further operative to receive caller identification (ID) information of the wireless unit in response to receiving the telephone call; and to
20 initiate one or more telephone connection requests to the wireless unit using the caller ID information during execution of the predetermined test process.

28. The computer test station according to claim 25, wherein the one or more processors are further operative to execute the predetermined test process
25 using one or more parameters comprising time information indicative of a time at which the predetermined test process is to be executed.

29. The computer test station according to claim 25, wherein the one or more processors are further operative to execute the predetermined test process

using one or more parameters comprising time information indicative of a time duration over which the predetermined test process is to be executed.

30. The computer test station according to claim 25, wherein the one or
5 more processors are further operative to execute the predetermined test process using one or more parameters comprising repetition information indicative of how many times a predetermined function will be executed.

31. The computer test station according to claim 25, wherein the one or
10 more processors are operative to execute a predetermined test process corresponding to an answered call test comprising the steps of:

initiating a telephone connection request to the wireless unit;

detecting if a connection was made with the wireless telephone unit in
response to initiating the telephone connection request;

15 repeating the initiating and detecting a total number of N times, wherein N is a number indicated in the one or more parameters; and

storing, at the computer test station, data indicative of a number of
connections made with the wireless unit during the repeated initiating and
detecting.

20

32. The computer test station according to claim 25, wherein the one or
more processors are operative to execute a predetermined test process
corresponding to a dropped call test function comprising the steps of:

25 sending audio signals during a telephone connection with the wireless unit;

detecting a disconnection with the wireless unit;

initiating a telephone connection request to the wireless unit if a
disconnection is detected;

30 repeating the sending, detecting, and initiating over a time period T,
wherein T is indicated in the one or more parameters; and

storing data indicative of a number of disconnections with the wireless unit over the time period T.

33. A method for use in testing the operation of a wireless unit within a
5 wireless communication system by a computer test station located remotely from the wireless unit, the method comprising:

receiving caller identification (ID) information associated with a wireless unit during a wireless communication therefrom;

receiving dual-tone multiple frequency (DTMF) signals from the wireless
10 unit during the wireless communication;

selecting one of a plurality of test functions based on the DTMF signals;

after termination of the wireless communication, executing the selected test function and receiving test data associated with the wireless unit; and
storing the test data in association with the caller ID information.

15

34. The method according to claim 33, further comprising:

repeating the steps of receiving, selecting, executing, and storing for one or more other wireless units.

20

35. The method according to claim 34, wherein executing the selected test function comprises executing an answered call test.

36. The method according to claim 34, wherein executing the selected test function comprises executing a dropped call test.

25

37. A method for use in simultaneously testing a plurality of wireless telephone units operative for wireless communications, the method comprising:

receiving first caller identification (ID) information associated with a first wireless unit;

performing a first test function during a first time period in connection with the first wireless unit and generating first test data therefrom;

storing the first test data in association with the first caller ID information;

receiving second caller identification (ID) information associated with a
5 second wireless unit;

performing a second test function during a second time period in connection with the second wireless unit and generating second test data therefrom; and

storing the second test data in association with the second caller ID
10 information.

38. The method according to claim 37, wherein the first time period during which the first test function is performed may overlap with the second time period during which the second test function is performed.
15

39. A method for use in providing a telephone unit with remote access to functions of a computer processor, the method comprising:

receiving a telephone call from a telephone unit;

receiving a caller identification (ID) number of the telephone unit upon
20 receiving the telephone call;

comparing the caller ID number with a plurality of prestored caller ID numbers; and

granting or denying access to functions of the computer processor based at least in part on the comparing.
25

40. The method according to claim 39, wherein the granting or denying access further comprises:

granting access if the caller ID number matches one of the prestored caller ID numbers; and

denying access if the caller ID number does not match any one of the prestored caller ID numbers.

41 The method according to claim 39, further comprising:
5 receiving a personal identification number (PIN) selected at the telephone unit;
comparing the PIN with a prestored PIN associated with a prestored caller ID number that matches the received caller ID number; and
wherein granting or denying access is based at least in part on the
10 comparing of the caller ID number and the comparing of the PIN.

42. The method according to claim 39, further comprising:
receiving a personal identification number (PIN) selected at the telephone unit;
15 comparing the PIN with a prestored PIN associated with a prestored caller ID number that matches the received caller ID number;
wherein granting or denying access further comprises:
granting access if the caller ID number matches one of the prestored caller ID numbers and if the PIN matches the prestored PIN associated with the
20 prestored caller ID number; and
denying access if the caller ID number does not match any one of the prestored caller ID numbers or the PIN does not match the prestored PIN associated with the prestored caller ID number.

25 43 The method according to claim 39, further comprising:
if access is granted, receiving, at the computer processor during the telephone call, signals for selecting a function.

44. A method for use in testing the operation of a wireless telephone unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit, the method comprising:

initiating a telephone connection request to the wireless telephone unit;

5 detecting whether a connection was made with the wireless telephone unit in response to initiating the telephone connection request;

repeating the initiating and detecting N times; and

storing data indicative of a number of connections made with the wireless telephone unit during the repeated initiating and detecting.

10

45. The method according to claim 44, further comprising:

prior to initiating the telephone connection requests:

receiving a telephone call from the wireless telephone unit;

15 receiving, during the telephone call, signals for selecting a test function corresponding to the initiating, detecting, repeating and storing; and

wherein the repeated initiating and detecting is executed in response to selecting the test function.

46. The method according to claim 44, further comprising:

20 prior to initiating the telephone connection requests:

receiving a telephone call from the wireless telephone unit;

receiving, during the telephone call, signals for selecting a test function corresponding to the initiating, detecting, repeating and storing;

25 receiving, during the telephone call, signals for selecting the number N;

storing data indicative of the number N for subsequent use in executing the selected test function; and

wherein the repeated initiating and detecting is executed in response to selecting the test function.

30

47. The method according to claim 44, further comprising:
prior to initiating the telephone connection requests:

receiving a telephone call from the wireless telephone unit;

5 receiving, during the telephone call, signals for selecting a test
function corresponding to the initiating, detecting, repeating and storing;

receiving, during the telephone call, signals for selecting a time or
time delay for executing the test function;

storing data indicative of the time or time delay for executing the
test function; and

10 wherein the repeated initiating and detecting is executed at the selected
time or time delay in response to selecting the test function.

48. The method according to claim 44, further comprising:
prior to initiating the telephone connection requests:

15 receiving a telephone call from the wireless telephone unit;

receiving caller identification (ID) information of the wireless
telephone unit in response to receiving the telephone call;

receiving, during the telephone call, signals for selecting a test
function corresponding to the initiating, detecting, repeating and storing; and

20 wherein the repeated initiating and detecting is executed in response to
selecting the test function and in connection with the wireless telephone unit
associated with the caller ID information.

49. The method according to claim 44, further comprising:

25 prior to initiating the telephone connection requests:

receiving a telephone call from the wireless telephone unit;

receiving caller identification (ID) information of the wireless
telephone unit in response to receiving the telephone call;

30 receiving, during the telephone call, signals for selecting a test
function corresponding to the initiating, detecting, repeating and storing;

receiving, during the telephone call, signals for selecting the number N;

storing data indicative of the number N for subsequent use in executing the selected test function; and

5 wherein the repeated initiating and detecting is executed in response to selecting the test function and in connection with the wireless telephone unit associated with the caller ID information.

10 50. The method according to claim 44, further comprising:

prior to initiating the telephone connection requests:

receiving a telephone call from the wireless telephone unit;

receiving caller identification (ID) information of the wireless telephone unit in response to receiving the telephone call;

15 receiving, during the telephone call, signals for selecting a test function corresponding to the initiating, detecting, repeating and storing;

receiving, during the telephone call, signals for selecting a time or time delay for executing the test function;

20 storing data indicative of the time or time delay for executing the test function; and

wherein the repeated initiating and detecting is executed at the selected time or time delay in response to selecting the test function and in connection with the wireless telephone unit associated with the caller ID information.

25 51. A method for use in testing the operation of a wireless telephone unit within a wireless communication system by a computer test station located remotely from the wireless telephone unit, the method comprising:

sending audio signals during a telephone connection with the wireless telephone unit;

30 detecting a disconnection with the wireless telephone unit;

initiating a telephone connection request to the wireless telephone unit if a disconnection is detected;

repeating the sending, and any detecting and initiating, over a time period T; and

5 storing data indicative of a number of disconnections with the wireless telephone unit over the time period T.

52. The method according to claim 51, further comprising:
prior to sending:

10 receiving a telephone call from the wireless telephone unit;

receiving, during the telephone call, signals for selecting a test function corresponding to the repeated sending, detecting, and initiating; and

wherein the repeated sending, detecting, and initiating is executed in response to selecting the test function.

15

53. The method according to claim 51, further comprising:
prior to sending:

receiving a telephone call from the wireless telephone unit;

20 receiving, during the telephone call, signals for selecting a test function corresponding to the initiating and repeated sending, detecting, and initiating; and

receiving, during the telephone call, signals for selecting the time period T;

25 storing data indicative of the time period T for subsequent use in executing the selected test function; and

wherein the repeated initiating and detecting is executed in response to selecting the test function.

54. The method according to claim 51, further comprising:
prior to sending:

receiving a telephone call from the wireless telephone unit;

receiving, during the telephone call, signals for selecting a test
5 function corresponding to the initiating and repeated sending, detecting, and
initiating; and

receiving, during the telephone call, signals for selecting a time or
time delay to execute the test function;

storing data indicative of the time or time delay to execute the test
10 function; and

wherein the repeated sending, detecting, and initiating is executed at the
time or time delay in response to selecting the test function.

55. The method according to claim 51, further comprising:
15 prior to sending:

receiving a telephone call from the wireless telephone unit;

receiving caller identification (ID) information of the wireless
telephone unit in response to receiving the telephone call;

receiving, during the telephone call, signals for selecting a test
20 function corresponding to the initiating and repeated sending, detecting, and
initiating; and

wherein the repeated sending, detecting, and initiating is executed in
response to selecting the test function and in connection with the wireless
telephone unit associated with the caller ID information.

25

56. The method according to claim 51, further comprising:
prior to sending:

receiving a telephone call from the wireless telephone unit;

receiving caller identification (ID) information of the wireless
30 telephone unit in response to receiving the telephone call;

receiving, during the telephone call, signals for selecting a test function corresponding to the initiating and repeated sending, detecting, and initiating;

receiving, during the telephone call, signals for selecting the time
5 period T;

storing data indicative of the time period T for subsequent use in executing the selected test function; and

wherein the repeated sending, detecting, and initiating is executed in response to selecting the test function and in connection with the wireless
10 telephone unit associated with the caller ID information.

57. The method according to claim 51, further comprising:
prior to sending;

receiving a telephone call from the wireless telephone unit;
15 receiving caller identification (ID) information of the wireless telephone unit in response to receiving the telephone call;

receiving, during the telephone call, signals for selecting a test function corresponding to the initiating and repeated sending, detecting, and initiating;

20 receiving, during the telephone call, signals for selecting a time or time delay to execute the test function;

storing data indicative of the time or time delay to execute the test function; and

wherein the repeated sending, detecting, and initiating is executed at the
25 selected time or time delay in response to selecting the test function and in connection with the wireless telephone unit associated with the caller ID information.

58. A test station for testing the operation of a wireless telephone unit within a wireless communication system, the test station comprising:

a computer;

wireless communication test software residing on memory that is
5 accessible to the computer;

a computer telephony card coupled to the computer; and

the computer telephony card having a plurality of telephone line
interfaces, each telephone line interface associated with a respective one of a
plurality of telephone numbers of a hunt group.

10

59. The test station according to claim 58, wherein the plurality of
telephone numbers of the hunt group are accessible by an abbreviated dialing
telephone number.

15

60. A test station for testing a wireless telephone unit within a wireless
communication system, the test station comprising:

a computer;

wireless communication test software residing on memory that is
accessible to the computer;

20

a computer telephony card coupled to the computer; and

the computer telephony card having at least one telephone line interface
that is accessible by an abbreviated dialing telephone number.

25

61. The test station according to claim 60, further comprising:

the at least one telephone line interface comprising a plurality of telephone
line interfaces, each interface of the plurality of telephone line interfaces being
associated with a respective one of a plurality of telephone numbers of a hunt
group, the hunt group being accessible by the abbreviated dialing telephone
number.

30

62. A telecommunication system method for providing a plurality of wireless telephone units with remote access to a computer test station, the method comprising:

receiving an abbreviated dialing telephone number to establish a
5 telephone call connection;

selecting one of a plurality of telephone numbers of a hunt group that is associated with the abbreviated dialing telephone number, each one of the plurality of telephone numbers associated with a computer test station; and

facilitating the telephone call connection between a wireless telephone unit
10 and the computer test station with use of the selected telephone number.

63. The method according to claim 62, wherein the step of receiving comprises receiving the abbreviated dialing telephone number at a mobile telephone switch.

15

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TESTING METHODS AND APPARATUS FOR WIRELESS COMMUNICATIONS

5

ABSTRACT OF THE DISCLOSURE

Several testing methods and apparatus for wireless communications, such as a cellular telephone communications, are described. One method for use in
10 troubleshooting a problematic call in a wireless communication system by a computer test station includes the steps of receiving a telephone call from a wireless telephone unit while the wireless telephone unit is simultaneously connected in a call; receiving, during the telephone call, first information which identifies the wireless telephone unit and second information which identifies a
15 wireless switch utilized in the call; sending, during the telephone call, a trace command having the caller ID information to an address associated with the wireless switch; and receiving, in response to sending the trace command, call trace information including information that identifies a plurality of devices of the wireless switch utilized in the call. In response, the computer test station
20 delivers a message that includes this device information to, for example, the wireless telephone unit or a system maintenance computer for appropriate handling.

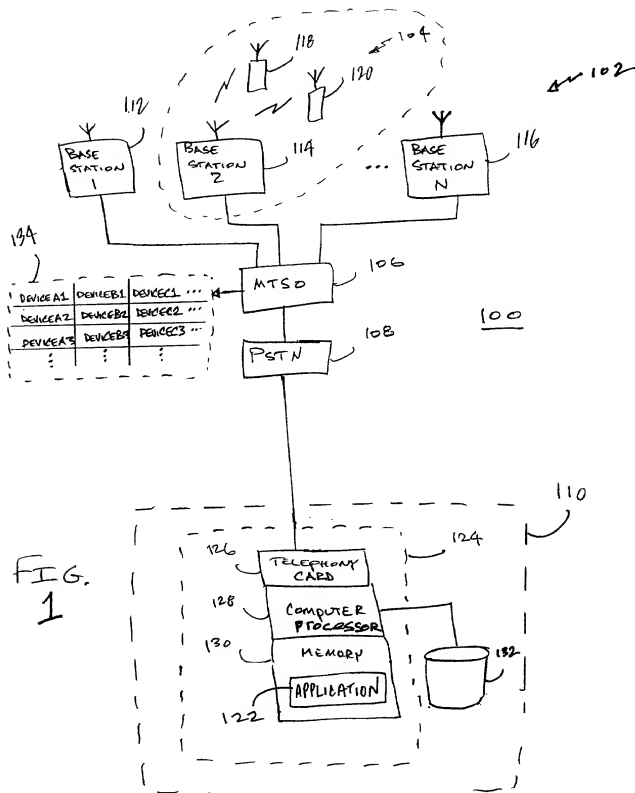


FIG.
 1

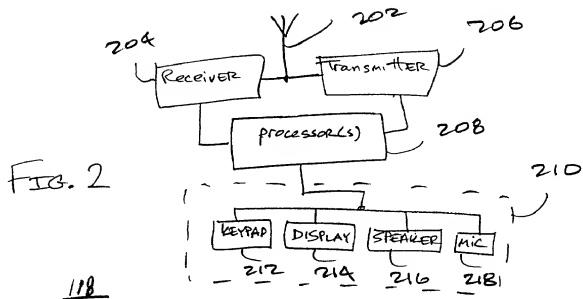
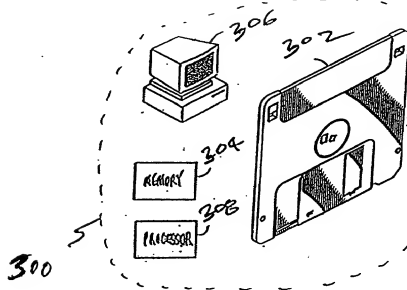


FIG. 3



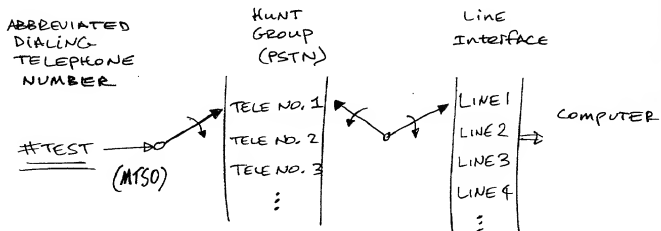


FIG. 4

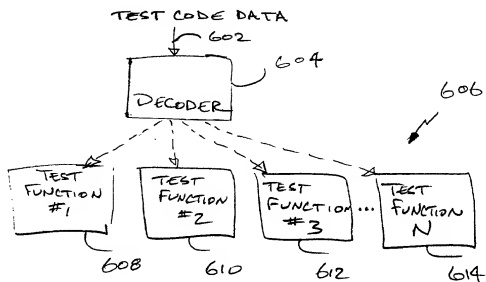


FIG. 6

FIG. 5

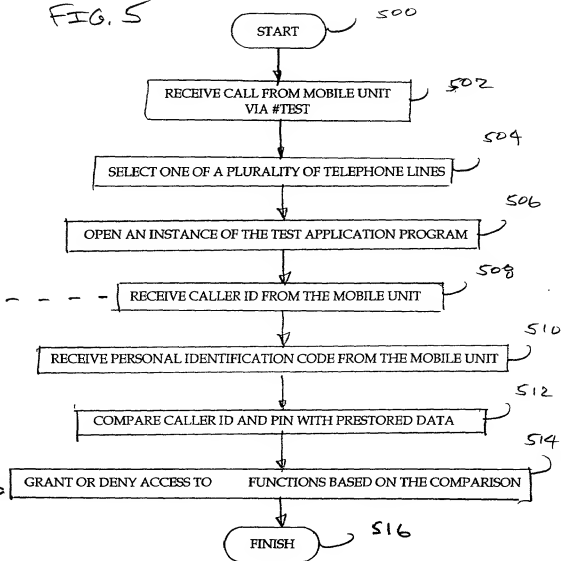


FIG. 7

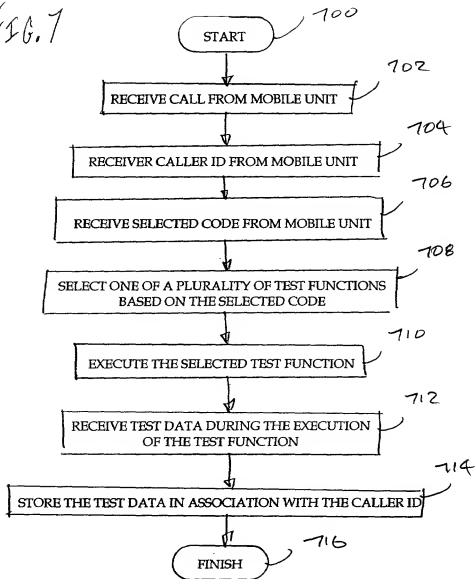


FIG. 8

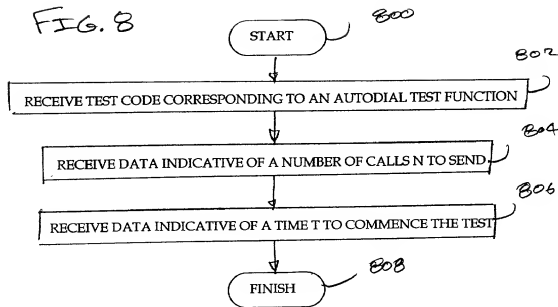


FIG. 9

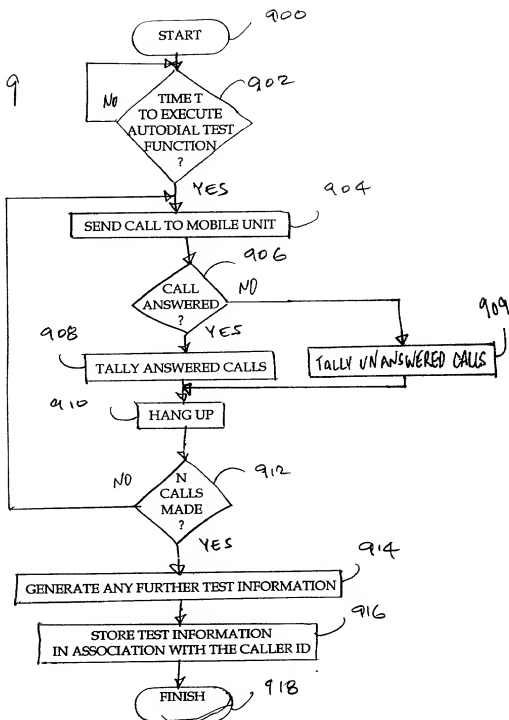


FIG. 10

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Example report for AutoDialer

Missed Call Detail from AutoTest			
Call Testing:	14:40:00		
Report Created:	2:20:03 PM		
Software version:	E2D	DATE	1.01
Mobile Number:	5617581425	5617581420	5617581421
Electronic Serial Number:	23108010239	22315105903	2350941275
Manufacturer:	MTR#1	MTR#2	MTR#3
Model:	688	70	6180
On Call Time:	12	12	12
Off Call Time:	2	2	2
Total Calls Attempted:	100	100	100
Total Calls Failed:	7	8	9
			21
114:40:01 Success	14:40:01 Success	14:40:01 Success	14:40:01 Success
214:40:28 Success	14:40:28 Success	14:40:28 Success	14:40:28 Success
314:41:05 Success	14:41:05 Success	14:41:05 Success	14:41:05 Success
414:41:31 Success	14:41:33 Success	14:41:32 Success	14:41:30 Failed
514:41:55 Success	14:42:00 Success	14:41:58 Success	14:41:59 Success
614:42:22 Success	14:42:26 Success	14:42:25 Success	14:42:25 Success
714:42:48 Success	14:42:53 Success	14:42:51 Success	14:42:53 Success
814:43:13 Success	14:43:20 Success	14:43:15 Success	14:43:16 Success
914:43:39 Success	14:43:47 Success	14:43:41 Success	14:43:43 Success
1014:44:06 Success	14:44:14 Success	14:44:07 Success	14:44:08 Success
1114:44:33 Success	14:44:41 Success	14:44:34 Success	14:44:34 Success
1214:45:00 Success	14:45:08 Success	14:45:02 Success	14:45:01 Success

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FIG. 11

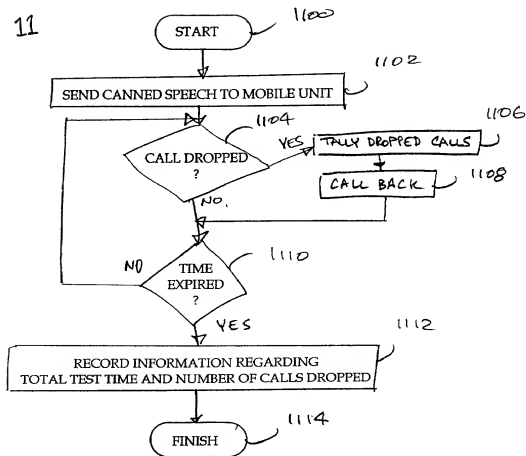
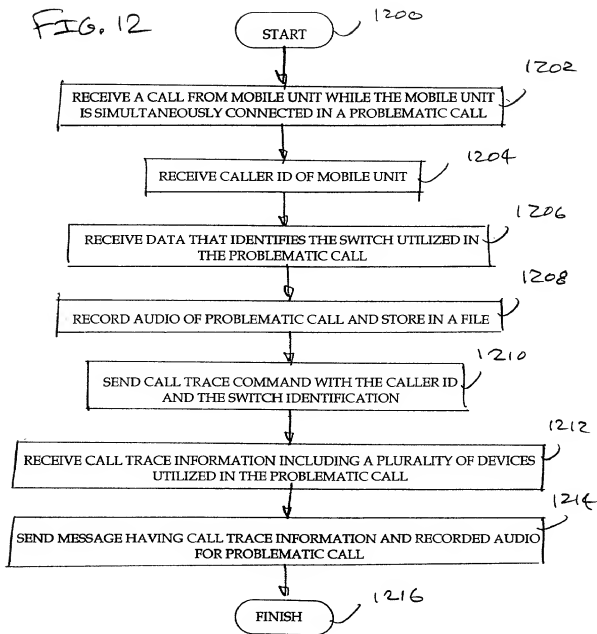


FIG. 12



IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **TESTING METHODS AND APPARATUS FOR WIRELESS COMMUNICATIONS**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119(a-d) pr 365(a-b) of PCT or foreign application(s) for patent or inventors' certificate listed below or priority benefits under 119(e) of any United States provisional application(s) listed below and have also identified below any foreign application for patent or inventors' certificate having a filing date before that of the application on which priority is claimed:

[None]

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, we acknowledge the duty to disclose all information known to us to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

[None]

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

Michele L. Conover	Reg. No. 34,962
Cedric G. DeLaCruz	Reg. No. 36,498
Samuel H. Dworetsky	Reg. No. 27,873
Rohini K. Garg	Reg. No. 45,272
Thomas M. Isaacson	Reg. No. 44,166
Benjamin S. Lee	Reg. No. 42,787
Robert B. Levy	Reg. No. 28,234
Susan E. McGahan	Reg. No. 35,948
Gary H. Monka	Reg. No. 35,390
Jeffrey M. Navon	Reg. No. 32,711
Stephen J. Pentlicki	Reg. No. 40,125
Thomas A. Restaino	Reg. No. 33,444
Alfred G. Steinmetz	Reg. No. 22,971

I also appoint Terrance A. Meador, Reg. No. 30,298; James P. Cleary, Reg. No. 45,843; Charles D. Gavrilovich, Jr., Reg. No. 41,031; Gerald W. Maliszewski, Reg. No. 38,054; John J. Oskorep, Reg. No. 41,234; Steven R. Sprinkle, Reg. No. 40,825; Mark M. Takahashi, Reg. No. 38,631; and Barry N. Young, Reg. No. 27,774 of Gray, Cary Ware & Freidenrich (USPTO Customer No. 25548) as associate attorneys with full power to prosecute said application, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office connected therewith.

Please address all correspondence to Mr. S. H. Dworetsky, AT&T Corp., P.O. Box 4110, Middletown, New Jersey 07748-4110. Telephone calls should be made to Thomas M. Isaacson at 301-812-1047. The facsimile number is 732-368-6932.

Full name of sole inventor: JAMES M. LIPSIT

Inventor's signature _____ Date _____

Residence:

Citizenship:

Post Office Address: